Environment and Ecology 40 (2) : 279—287, April—June 2022
ISSN 0970-0420

A Review on the Ecological Distribution, Antioxidant Properties and Antimicrobial Activity of Ethno Medicinal Fern *Drynaria quercifolia* (L.) J. Smith

Subash Kumar Gupta, Jnan Bikash Bhandari

Received 25 January 2022, Accepted 19 March 202, Published on 1 April 2022

ABSTRACT

Drynaria quercifolia (L.) J. Smith is generally known as oak leaf fern of the family Polypodiaceae of Pteridophyta. It is an important medicinal plant used in traditional medicinal system to cure health problems. Various phytochemicals like 3,4-dihydroxybenzoic acid, friedelin, epifriedelinol, β-amyrin, β-sitosterol and β-sitosterol 3-β-D-glucopyranoside has been isolated from the plant. The rhizome is reported to antimicrobial, antioxidant, wound healing, bone regenerative activity and various other activities of traditional and medicinal uses. *Drynaria quercifolia* are the valuable source of natural antioxidants. The antioxidant activity of different rhizome fractions of *Drynaria quercifolia* on the basis of its DPPH scavenging activity. The rhizome extract of *Drynaria quercifolia* reported of antibacterial activity. The antibacterial activity of these extracts was due to the active principle present in the extracts. This review has been aim to provide scientific information of phytochemical constituents, anti-oxidant and anti-microbial activity of *Drynaria quercifolia* which is a potent folklore ethno-medicinal plants.

Keywords *Drynaria quercifolia*, Rhizome, Saponin, antimicrobial, Antioxidant.

INTRODUCTION

Medicinal plants contain numerous phytoconstituents such as flavonoids, saponins, quinines, terpenoids, glycosides, alkaloids, tannins, polyphenols , fats and oils which are responsible for their ethno-medicinal activities. Ferns are known as vascular cryptogams occupy strategic place between seed- bearing spermatophytes and the non – seed bearing cryptogams dispersed throughout the world. Ferns are used in different traditional medicinal systems of India and some other part of world. In ancient Indian medicine, several ferns were used and in particular by Unani physicians in India and Western Asia (Mondal and Mondal, 2011). Ferns play significant role in folklore medicine. *Drynaria quercifolia* (L.) J. Smith is an important ethno medicinal plant used in traditional medicinal system by different group of people to cure various kinds of health problems. *Drynaria quercifolia* is an epiphytic medicinal pteridophye, belongs to family Polypodiaceae, commonly known as oak leaf fern distributed in the evergreen forests of India. It is native to tropical areas of Asia, Africa and Australia

Subash Kumar Gupta*
Assistant Professor, Botany Department, North Bengal St. Xavier's College, Jalpaiguri-735134, West Bengal (India)

Jnan Bikash Bhandari
Associate Professor, Botany Department, University of North Bengal, Darjeeling-734013, West Bengal (India)
Corresponding author, Email: guptasubash60@yahoo.in

and considered as mostly as a medicinal plant. It plays a key ethno-medical role in many countries, especially in Asia. The rhizome is reported to be used by tribal communities of south India to cure various diseases like dyspepsia and cough. The leaves are used to treat body pain, headache and with other drugs in rheumatic ache. The whole plant of *Drynaria quercifolia* is anthelmintics, and trditionalyy used to cure skin diseases and loss of appetite. The plants are known to have therapeutic uses in tuberculosis, fever. The fronds are pounded and used as a poultice for swelling because of its antibacterial properties. Rhizome and roots of these plants are used as stimulant in typhoid fever. It is very particularly used in the treatment of migraine. Traditional use of this drug is in diarrhoea, jaundice, syphilis typhoid and cholera. Parihar *et al.* (2010) reported *in vitro* antimicrobial activity of some important pteridophytes fronds against isolated skin pathogen. Thomas (2012) reported the *in vitro* antibacterial activity of *Acrostichum aureum* Linn. against isolated skin pathogens of human beings. Mithraja *et al.* (2012) used rhizome extract of *Drynaria quercifolia* against urinary tract bacterial pathogens for antibacterial activity. Nayar *et al*. (2013) also reported the antibacterial activity of terrestrial fern, *Lygodium fexuosum* (L.) Sw. against multidrug resistant bacteria. The rhizome *Drynaria quercifolia* is also reported to have anti fertility, anti-inflammatory, anti-pyretic, anti-bacterial, anti-pyretic, and anti-ulcer properties (Nithin *et al.* 2020). Various studies have been reported on the antibacterial activity of fern extracts.

Ecological distribution and morphology of *Drynaria quercifolia*

Drynaria quercifolia (L.) J. Smith is commonly known as oak leaf fern of the family Polypodiaceae of Pteridophyta is distributed widely in the evergreen forests. *Drynaria quercifolia* can be either epiphytic as they grow on trees trunks or epipetric as some are grow on rocks. It is native to Western Australia, Southeast Asia, Indonesia, Philippines, Malaysia, New Guinea, Africa and as well as in India. It is cultivated mostly as a medicinal plant in many Asian countries, such as China, Thailand, Taiwan and Vietnam. It plays a key ethno-medical role in many countries, particularly in Asia. *Drynaria quercifolia* (L.) J. Smith is short height plant, ranges from 60-100 cm long having long-creeping, a thick, densely scaly brown rhizome. Fronds are dimorphic, sterile fronds and fertile fronds. Sterile fronds usually brown in color and much shorter than the fertile ones. Fertile fronds are generally green in color. Sporangia are found on fertile leaves only, in punctiform sori, over the vein plexuses forming two irregular rows between adjacent main lateral veins of the lobes and non-indusiate. Spores are bilateral with very minute sparse echinations on the exine. Gametophytes are cordate with marginal club-shaped unicelluar hairs (Negi *et al.* 2009).

Importance of *Drynaria quercifolia* in ethno-medicinal system

Drynaria quercifolia is used in medicinal system by different groups of people to treat various kinds of health related problems. It plays an important role in traditional Indian Ayurvedic medicine. In Ayurvedic system of medicine, it is known as 'Ashwakatri' use by different tribal people for the treatment of chest disease, cough, hectic fever, dyspepsia, loss of appetite, chronic jaundice (Nayar 1959). Generally the soup prepared from the rhizome of *D. quercifolia* is very popular among tribes of Tamil Nadu, Eastern Ghats and the soup drink to get relief from rheumatic complaints (Samydurai *et al*. 2012).The roots are being used in Ayurveda, the ancient Indian system, to stimulate appetite, relieve flatulence and as a general tonic. Tribals in kalakad, Mundanthurai Tiger Reserve India, utilizes its rhizome to cure rheumatism (Pargavi and sivakumar 2017). Manjula and Norman (2017) eported that the epiphytic fern gives the helping hand to people who suffer from relapsed, drug–resistant tuberculosis. This study is done to analyze the efficiency of the rhizome of *Drynaria quercifolia* as a case study of a 29 year old male who visited a tribal healer from Malasar community in the study area Velliangiri hills which is located in the eastern part of Western Ghats, India.

Phytochemical analysis of *Drynaria quercifolia*

Phytochemicals are chemicals derived from plants are often used to describe the large number of secondary metabolic compounds found in plants. Phytochemical

Table 1. Phytochemical screening of *Drynaria quercifolia* rhizome (Prasanna *et al.* 2015). (+) -positive, (-)-negative.

Sl. No.	Phytochemicals	Results methanol extract	Petroleum ether extract
1	Tannins	+	+
2	Phlobatannins	-	-
3	Saponins	+	+
4	Flavonoids	+	-
5	Steroids	+	-
6	Terpenoids	-	-
7	Coumarins	+	+
8	Alkaloids	+	-
9	Glycosides	+	+
10	Carbohydrate	+	+
11	Phytosterols	+	+
12	Fixed oil and fats	+	+
13	Phenol	+	+
14	Protein and aminoacids	+	-
15	Cholinergic acid	+	-

screening assay is a simple, speedy procedure that gives the researcher a quick answer to the various types of phytochemicals in a mixture and key tool in bioactive compound analyses. After the preparation of the crude extract or active fraction from plant material, phytochemical screening can be performed with the proper tests to get an idea regarding the type of phytochemicals existing in the crude extract or fraction. Usually the identified components from plants extract active against microorganisms are saturated or aromatic organic compounds, they are frequently obtained through initial ethanol or methanol extraction (Vilegs *et al.*1997). The curative value of these plants lies in some chemical substances that produce a specific physiological action on the human body. The majority of these bioactive constituents of plants are tannins, alkaloids, flavonoids and phenolic compounds. The plant part used in folk medicine of *Drynaria quercifolia* are rhizomes (Table 1).

Janarthanan *et al.* (2016) reported that the Preliminary phytochemical screening of appropriate solvent extracts of rhizome of *Drynaria quercifolia.* They found the presence of sterols, tannins, proteins and amino acids, flavonoids, terpenoids, saponin, carbohydrates and absence of alkaloids, glycosides and volatile and fixed oil. Extraction is the crucial first step in the analysis of medicinal plants, because it is essential to extract the desired chemical components from the plant materials for further analysis and characterization. The necessary steps included steps, such as pre-washing, drying of plant materials or freeze drying, grinding to acquire a homogenous sample and often improving the kinetics of analytic extraction. Proper precautions must be taken to assure that potential active constituents are not lost or destroyed during the preparation of the extract from plant samples (Table 2).

Ramesh *et al.* (2001) reported that the dried rhizomes of *Drynaria quercifolia* contained following phytoconstituents; friedelin, epifriedelinol, ß-amyrin, ß-sitosterol 3-beta-D-glucopyranoside and naringin. Prakash *et al.* (2010) used TLC method to identify the constituents, present in different extracts of rhizome of *Drynaria quercifolia.* Padmaselvi *et al.* (2016) reported the physicochemical, fluorescence, histochemical and phytochemical analysis of methanol extract of *Drynaria quercifolia* rhizome. In physicochemical analysis, parameters such as moisture content (3%), water soluble ash (6%), sulfated ash (5%), alcohol soluble extractive value (7%) and water soluble extractive value (9%) of plant were determined. In fluorescence analysis, dissimilar colors of fluorescent were observed under UV and visible light. The histochemical analysis indicates the presence of lignin, flavonoids, alkaloids and polyphenol generally based on colors. Quantitative phytochemical analysis of their report revealed the chief amount of flavonoids (32.84 mg/g), saponin (32.74 mg/g), phenols (84.56 mg/g), tannins (45.23 mg/g) and alkaloids (6.38 mg/g). Nithin *et al*. 2020 also reported that the GC-MS analysis of ethanolic extract of rhizome of *Drynaria quercifolia* showed 11 bioactive compounds, the highest compound was found as 2-myristynol-glycinamide (22.502%) and lowest compound was named as 6-amino-5-cyano-4-(3-iodophenyl)-2-methyl-4H-pyron-3-carboxylic acid ethyl ester (4.505%) (Table 3).

Antioxidant activity

Plants represent a rich source of antioxidants and antimicrobial agent. The various authors reported that the *Drynaria quercifolia* are the valuable source of natural antioxidants. Oxidation and reduction reac-

Table 2. Phytocomponents identified in the methanolic extracts of *Drynaria quercifolia* rhizome by using GC-MS (Prasanna *et al*. 2015).

Sl. No.	R. time	Name of the compound	M. formula	MW	Peak area%
1.	4.354	Pentanoic Acid, Methyl Ester	$C_6H_{12}O_2$	116	0.29
2.	9.780	Undecane (Cas) N-Undecane	$C_{14}H_{24}$	156	0.46
3.	13.255	Cyclohexasiloxane, Dodecamethyl-	$C_{12}H_{36}O_6$	444	0.32
4.	21.633	1, 2-Benzenedicarboxylic Acid, Diethyl Ester	$C_{12}H_{14}O_4$	222	36.05
5.	31.731	1, 2-Benzenedicarboxylic Acid, Diethyl Ester	$C_{12}H_{14}O_4$	222	36.05
6.	23.209	Cyclooctasiloxane, Hexadecamethyl-	$C_{16}H_{48}O_8Si_8$	592	1.87
7.	25.700	1,3-Diphenyl-1, 3, 5, 5-Tetramethyl-yclotrisiloxane	$C_{16}H_{22}O_3Si_3$	346	6.08
8.	26.163	Benzenesulfonamide, 3-Amino-4 Hydroxy-	$C_6H_8N_2O_5S$	188	0.82
9.	26.274	Octadecamethylcyclononasiloxane	$C_{18}H_{54}O_9Si$	666	0.78
10.	27.108	Benzenepropanoic Acid., Alpha.,4-Bis (Acetyloxy), Methyl Ester	$C_{14}H_{16}O_6$	280	1.54
11.	27.221	1, 2-Benzenedicarboxylic Acid, Bis (2-Methylpropyl) Ester	$C_{16}H_{22}O_4$	278	3.74
12.	27.285	2-Pyridinepropanamide, N-Phenyl	$C_{14}H_{14}N_2O$	226	1.95
13	27.419	Silane, {1, 3, 5-Benzenetriyltris (Oxy)] Tris [Trimethyl-	$C_{15}H_{30}O_3Si_3$	342	3.66
14.	27.975	Hexadecanoic Acid, Methyl Ester (Cas) Methyl Palmitate	$C_{17}H_{34}$	270	3.33
15	28.495	Palmitic Acid	$C_{18}H_{32}O_2$	256	2.18
16,	28.673	1, 2-Benzenedicarboxylic Acid, Dibutyl Ester	$C_{16}H_{22}O_4$	278	3.08
17.	29.396	Nonamethyl, Phenyl, Cyclopentasiloxane	$C_{15}H_{32}O_5Si_5$	432	0.89
18.	30.283	1-Octadecanol	$C_{18}H_{38}O$	270	0.36
19	30.386	9, 12-Octadecadienoic Acid (Z, Z)-, Methyl Ester	$C_{19}H_{34}O_2$	294	3.26
20.	30.450	0-Octadecenoic Acid (Z)-, Methyl Ester	$C_{19}H_{36}O_2$	296	0.93
21.	30.653	Tetracosamethylcyclododecasiloxane	$C_{24}H_{72}O_{12}Si_{12}$	888	0.23
22.	30.747	Octadecanoic Acid, Methyl Ester	$C_{19}H_{38}O_2$	298	0.24
23.	30.925	Octadec-9-9-Enoic Acid SS 9-Octadecenoic Acid	$C_{18}H_{34}O_2$	282	0.57
24.	31.497	Pentamethyl Phenyl-Disilane	$C_{11}H_{20}Si_2$	208	1.20
25.	32.608	4-P-Chorophenyl-2-Dimethylamino-5-Nitrosothiazole	$C_{12}H_{13}N_3OS$	247	6.57
26.	33.962	1.26 Pentamethyl Phenyl-Disilane	$C_{11}H_{22}Si_2$	208	1.26
27	34.593	(4-chlorophenyl) Methanesulfonamide	$C_2H_8CINO_2S$	205	1.10
28.	37.299	Cyclooctasiloxane, Hexadecamethyl	$C_{16}H_{48}O_8Si_8$	592	0.48
29.	38.298	1, 2-Benzenedicarboxylic Acid, Disooctyl Ester	$C_{24}H_{38}O_4$	390	1.70
30.	38.553	Phosphine Oxide, Triphenyl-	$C_{24}H_{38}O_4$	390	1.11

tions are important to many living organisms for the production of energy to metabolic processes. Oxygen free radicals and other reactive oxygen species (ROS) which are continuously produced in living organism, result in cell death and tissue damage. These species can react with biological substrates such as DNA and

Table 3. Phytocomponents identified in ethanolic extract of rhizome of *Drynaria quercifolia* by using GC-MS (Nitin *et al.* 2020).

Sl. No.	RT	Compound name	Mol formula	Mol Wt	%Peak area	Compound nature
1.	27.693	2,4,6-cyclo ptat rnen-1 one 3, 5-bis-tnmethylstlyl	$C_{11}H_{22}OSI_2$	250	10.092	Ahpbatic
2.	28.024	1, 2-bis (trumethyldtlvl) benzene	$C_{12}H_{22}SI_2$	222	7.444	Aromatic
3.	28.159	2-propanol 1-chloro-3 (1-methylethoxy)	$C_4H_{11}O_2CI$	152	10.492	Alcohol and Ether
4.	28.289	Silane1.4-phenylene brs trumethy	$C_{12}H_{22}SI_2$	222	12.077	Aromatic
5.	28.434	2,6-lutidine 3.5-dicholoro-4-dodecylthio-	$C_2H_{14}O$	375	10.038	Not identified
6.	28.584	1-heptyn-4-ol	$C_2H_{14}O_2CL$	114	4.949	Alcohol
7.	26.694	2-propanol 1 -chlom-3-propoxy	$C_6H_{13}O_2CL$	152	7.370	Ether and Alcohol
8.	28.869	6-amino-5-cyano-4 (3-iodophenyl)-2-methyl-4H-pyton-3-carboxvlic acid ethvl ester	$C_{16}H_{12}N_{21}$	410	4.505	Not identified
9.	29.014	2-mynstynol- glycinamade	$C_{16}H_{28}O_2N_2$	280	22.502	Not identified
10.	29.354	Benzene 2-(tert-butyldunethvl stlyl) -1-isopropyl)-4-methy	$C_{16}H_{28}OSI$	264	4.730	Aromatic
11.	30.214	1,2,4-benzene in carboxylic acid 1,2-demethyl ester	$C_{11}H_{10}O_6$	238	5.801	Aronatic

Table 4. Antioxidant activities of rhizome extract of *Drynaria quercifolia* by DPPH method (Beknal *et al.* 2010).

Extracts of *Drynaria quereifolia*	Concentration in PPM	% Scavenging activity
Pet-ether	25	15.98
	50	24.67
	100	38.97
	250	63.99
	500	68.54
Chloroform	25	12.43
	50	22.54
	100	39.55
	250	54.66
	500	66.83
Mothanol	25	17.75
	50	17.67
	100	65.99
	250	79.12
	500	94.37
Water	25	13.45
	50	28.56
	100	32.67
	250	44.88
	500	54.76
α-tocopherol	25	14.65
	50	32.87
	100	55.98
	250	70.34
	500	86.27

proteins, leading to several diseases including cancer, diabetes, cardiovascular diseases, aging and arthritis. It has been recommended that the ingestion of dietary antioxidants suppress the free radical production or scavenge free radicals and may prevent harmful effect of these radicals. Some phytochemicals i.e., flavanoids, pigments and vitamins are known to be potent antioxidants. Beknal *et al.* (2010) reported that the antioxidant properties of methanol extract of rhizome of *Drynaria quercifolia* by DPPH assay. The extracts was tested against a methanolic solution of DPPH (α, α- diphenyl - β - picryl hydrazyl) antioxidants react with DPPH and convert it to α, α- diphenyl- β - picryl hydrazine. The degree of discoloration indicates the scavenging potentials of the antioxidant extract (Table 4).

Beknal *et al.* (2010) reported thatall the extracts at a concentration of 500 ppm have shown very good antioxidant activity. Among the rhizome extracts of Drynaria quercifolia only methanolic extract at 500ppm has shown activity above 90%. Higher activity has been shown by the methanolic rhizome extracts of *Drynaria quercifolia* than standard α-tocopherol. Mohanta *et al*. (2013) measured the antioxidant activity of different rhizome fractions of *Drynaria quercifolia* on the basis of its DPPH scavenging activity in which carbon tetra chloride and ethyl acetate showed strong antioxidant activity. Sasikumar *et al*. (2014) reported that the polyphenolic composition and antioxidant properties of methanol extract of rhizome of *Drynaria quercifolia* by DPPH assay, hydroxyl ion radicals (˙OH), nitric oxide (NO), hydrogen peroxide (H_2O_2) and 2, 2'-Azinobis (3-ethylbenzothiazoline sulfonic acid) ABTS scavenging assays. The antioxidant capacities of the extract were stronger than that of the antioxidant standard, butyl hydroxy toluene (BHT) when compared with other medicinal ferns. There is an increasing concern in antioxidants, particularly in those anticipated to prevent the presumed deleterious effects of free radicals in the human body and to prevent the worsening of fats and other constituents of foodstuffs. In both cases, there is a preference for antioxidants from natural sources rather than from synthetic sources (Abdalla and Roozen 1999).

Antimicrobial properties

The presence of medicinal properties of fern has been reported by many authors. Chopra and his colleagues (1933) and Kirtikar *et al*. (1975) worked on 44 and 27 species of ferns respectively and reported on the medicinal uses of these Pteridophytic plants. Medicinal uses of fern species were also described by Nadkarni (1954), Nayar (1959). They also reported that 29 species of ferns were used in preparation of medication. May (1978) reported a detailed review of various ferns and their medicinal values. Higher plants are basically rich in active principles, which are generally used as therapeutic drugs (Evans *et al.* 1986). The antibacterial activity of some ferns has been reported by (Kumar and Kausik 1999. Parihar and Bohra 2000a and b, 2003). *Drynaria quercifolia* shows one of the potential sources of antimicrobial properties.The extract of this fern was capable of inhibiting wildtype and multidrug-resistant bacteria such as *Neisseria gonorrhoeae* and *Streptococcus-β-haemolyticus* (khan et al. 2017). In general,

Table 5. Inhibitory properties (inhibition zone diameter in mm) of rhizome extracts of *Drynaria quercifolia* on different pathogenic bacteria (Kandhasamy *et al.* 2008). Crude extractused (10µl). Inhibition Zone diameter includes the diameter of the disc (6 mm)..

	Inhibition zone diameter in mm (Mean ±SD) Different solvents extracts						
Test organisms	Positive control chloramphenical	Ethanol	Methanol	Pet.ether	Hexane	Banzene	Chlorotorm
E. coli	14 ± 0.0	10 ± 0.2	10 ±0.2	ND*	ND*	10 ±0.2	8 ± 0.2
K. pneumoniae	9 ± 0.0	8 ± 0.2	8 ±0.2	ND*	ND*	ND*	ND*
P. mirabilis	15 ± 0.0	13 ± 0.4	11 ± 0.2	ND*	ND*	ND*	8 ± 0.4
P. aeruginosa	11 ± 0.0	8 ± 0.2	10 ±0.2	ND*	ND*	11 ± 0.4	8 ±0.4
S. typhi	11 ± 0.0	11 ± 0.4	ND*	ND*	ND*	11 ± 0.4	ND*
S. paratyphi A.	10 ± 0.0	9 ± 0.3	ND*	ND*	ND*	7 ± 0.3	ND*
S. paratyphi B	10 ± 0.0	11 ± 0.5	11 ± 0.5	ND*	ND*	8 ± 0.2	ND*
S. marscence	12 ± 0.0	ND*	ND*	ND*	ND*	ND*	ND*
S. aureus	10 ± 0.0	11 ± 0.4	10 ±0.0	ND*	ND*	ND*	13 ± 0.6
B. subtilis	12 ± 0.0	ND*	8 ±0.4	ND*	ND*	ND*	ND*

gram-negative bacteria were more resistant to antibiotics than gram-positive bacteria (Paz *et al*. 1995, Chowdhury and Islam, 2004). The resistance is due to the differences in their cell wall composition. In gram-negative bacteria the outer membrane acts as a great barrier to many environmental substances including antibiotics (Tortora *et al*. 2001). Presence of thick murine layer in the cell wall prevents the entry of the inhibitors (Martin, 1995).The fertile fronds (leaves) of Drynaria quercifolia which are sometimes used in conjunction with the rhizome to treat tuberculosis and throat infections (Sen and Ghosh 2011). Kandhasamy *et al.* (2008) reported that organic solvents such as ethanol, methanol, petroleum ether, hexane, benzene and chloroform were used to extract the bioactive compounds from the rhizome of *Drynaria quercifolia.* These bioactive compounds they screened for the antibacterial activity against infectious disease causing bacterial pathogens such as *Escherichia coli, Klebsiella pneumoniae, Proteus mirabilis, Pseudomonas aeruginosa, Salmonella typhi, Salmonella marscence, Salmonella paratyphi A, Salmonella paratyphi B*, *Staphylococcus aureus* and *Bacillus subtilis* by agar diffusion method. The ethanolic extract of *D. quercifolia* was found more active against 80% of the organisms tested. They also found that the methanolic extract (70%), benzene (50%) and chloroform extract (40%) in inhibiting the growth of the organisms tested. Petroleum ether and hexane extract of rhizome of *Drynaria quercifolia* did not showed any antibacterial activity against the pathogenic bacteria tested in the experiment. The broad spectrum of antibacterial activity of these extracts was due to the active principle present in the extracts. The active principle may be polar compounds like saponins (Singh and Gupta 2008) responsible for broad spectrum of antibacterial activity (Table 5.).

Mohanta *et al.* (2013) also reported that the an timicrobial activity of rhizome of *D. quercifolia* . They observed that the ethyl acetate and carbon tetra chloride fraction showed mild antimicrobial activity against gram positive and gram negative bacteria (Table 6).

DISCUSSION

Drynaria quercifolia is ethno medicinal fern used in folklore medicine throughout the world. The presence of variety of phytochemicals such like 3,4-dihydroxybenzoic acid, friedelin, epifriedelinol, β-amyrin, β-sitosterol and β-sitosterol 3-β-D-glucopyranosid reported from *Drynaria quercifolia* are potential source for preparation of medicaments against different ailments. *Drynaria quercifolia* has a wide range of phytochemicals which could be useful for treatment of various diseases. *Drynaria quercifolia* are the valuable source of natural antioxidants. Beknal *et al.* (2010) reported that the antioxidant activity of different rhizome fractions of *Drynaria quercifolia* on the basis of its DPPH scavenging activity in which carbon tetra chloride and ethyl acetate showed strong antioxidant activity. In folklore medicinal plant Drynaria

Table 6. Inhibitory properties (inhibition zone diameter in mm) of rhizome extracts of *Drynaria quercifolia* on different microorganism (Mohanta *et al*. 2013).

Test Microarganisms	Diameter of the zone of inhibition (mm)				
	PESF	CTSF	EASF	WSF	Ciprofloxacin
		Gram positive bacteria			
Bacillus cerus	-	–	-	-	44
Bacillus megaterium	-	8	-	-	46
Bacillus subtilis	-	8	8	-	45
Staphylococcus aureus	-	8	8	-	44
Sarcina lutea	-	-	9	-	43
		Gram negative bacteria			
Escherichia coli	-	8	8	-	43
Pseudomonas aeruginosa	-	8	8	-	42
Salmonella paratyphi	-	8	8	-	44
Salmonella typhi	-	8	8	-	44
Shigella boydi	-	-	8	-	44
Shigella dysenteriae	-	8	8	-	42
Vibrio mimicus	-	8	8	-	45
Vibrio parahemolyticus	-	8	8	-	43
		Fungi			
Candida albicans	-	9	9	-	44
Aspergillus niger	-	8	8	-	44
Saccharomyces cerevaceae	-	8	8	-	44

mostly using for treatment of stomach ache, peptic ulcers, dysentery, gastro-intestinal disorders; wound, abscess, eczema and scabies like skin problems, cold, cough, jaundice, fever, urinary complaints, fracture of bones, hypertension, glandular swellings, snake bite and also used as a tonic for vigour. Many organic solvents such as ethanol, methanol, petroleum ether, hexane, benzene and chloroform were used to extract the bioactive compounds from the rhizome of *Drynaria quercifolia.* The different solvent extracts of the rhizome of *Drynaria quercifolia* showed antibacterial activities. It was observed in the present study that the ethanolic and methanolic extracts inhibited the growth of pathogenic bacteria 80 and 70% respectively (Kandhasamy *et al*. 2008) .The antibacterial activity of these extracts was due to the presence of active principle present in the extracts, may be polar compounds like saponins (Singh and Gupta 2008). Many reports were done on screening of rhizome of *Drynaria quercifolia* both *in-vivo* and *in-vitro* exhibited its potency to cure diseases as because the antibacterial activity of these extracts was due to the active principle present in the extracts. Thus this paper article has been aim to provide scientific information of phytochemical constituents, anti-oxidant and anti-microbial activity of *Drynaria quercifolia* which is a potent folklore ethno-medicinal plants.

REFERENCES

Abdalla AE, Roozen JP (1999) Effect of plant extracts on the oxidative stability of sunflower oil and emulsion. *Food Chem* 64:323-329.

Chowdhury AA, Islam MS (2004) Antibacterial activity of *Trema orientalis*. *Dhaka Univ J Pharamac Sc*i 3(1-2): 115-117.

Chowdhury MMK, Hossain MJ, Uddin MA (2017) Cataractostatic activity of *Drynaria quercifolia* tuber extract. Biores *Commum* 3(2):411-414.

Deb L, Das B, Choudhury MD, Dey A, Talukdar AD, Nongalleima K (2014) Anti-oxidant and anti-inflammatory activity of aqueous and methanolic extracts of rhizome part of *Drynaria quercifolia* (L). J. Smith. *Int J Pharm Sci* 6 (6) 43-49.

Evans JS, Pattison E, Moris P (1986) Antimicrobial agents from plant cell culture, in secondary metabolites in plant cell culture (edited by Moris PA, Scraggs A, Stafford A, Flower M) Cambridge University, London.

Gordon MC, David JN (2001) Natural product drug discovery in the next millennium. *Pharm Biol* 39: 8-17.

Khan A, Haque E, Rahman MM, Mosaddik A, Rahman M, Sultana N (2007) Isolation of antimicrobial constituent from rhizome of *Drynaria quercifolia* and its sub-acute toxicolog, ical studies. *DARU* 15 (4) :205–11.

Kulkarni GK, Kadolkar RV, Maisale AB (2010) Anthelmintic activity of *Drynaria quercifolia* (L.) J Smith. *J Pharma Res* 3(5): 975-977.

Jain (1992) Glossary of Indian medicinal plants, second supple ments (NISc Communication) New Delhi-12. Part –I,

Janarthanan L, Karthikeyan V, Balakrishnan BR, Jaykar B, Senthilkumar KL, Anandharaj G (2016) Pharmacognostical standardization and phytochemical profile of rhizomes of *Drynaria quercifolia* (L.) J Smith. *Europ J Biomed phar maceut Sci* 3 (8) : 278-287.

Kandhasamy M, Arunachalam MD, Thatheyus AJ (2008) *Drynaria quercifolia* (L.) J Smith A potential resource for antibacterial activity. *Afr J Microbiol Res* 2: 202-205.

Khan A, Islam MH, Islam ME. Al-Bari MA, Parvin MS, Sayeed MA, Islam MN, Haque ME (2014) Pesticidal and pest repellency activities of rhizomes of *Drynaria quercifolia* (J Smith) against *Tribolium castaneum* (Herbst) *Biol Res* 47(1): 51.

Kumar A, Kaushik P (1999) Antibacterial effect of *Adiantum capillus-veneris Linn. Ind Fern J* 16 (1):72-74.

Manjula V, Norman TSJ (2017) *Drynaria quercifolia:* A luring cure for chronic pulmonary obstructive disease with relapsed tuberculosis. *The Pharma Innova J* 6 (11): 109-111.

May IW (1978) The economic uses and associated folklore of ferns and fern allies. *Bot Rev* 44: 191-528.

Martin GJ (1995) Ethnanobotany, A Methods Manual. Chapman and Hall, London.

Mithraja MJ, Irudayaraj V, Kiruba S, Jeeva S (2012) Antibacterial efficacy of *Drynaria quercifolia* (L.) J Smith against clinically isolated urinary tract pathogens. *Asia Pacific J Trop Biomed* 2(1): 1-5.

Mohanta MC, Dey A, Reham SA, Choudhary RN (2013) Evaluation of anti-oxidant, cytotoxic and antimicrobial properties of *Drynaria quercifolia Int Res J Pharma* 4 (7) : 46-48.

Mohanta MC, Ganguly A, Begum F, Rahman SMA (2014) Evaluation of anti-nociceptive properties of *Drynaria quercifolia* rhizome in Swiss-albino mice. *J Pharma Res* 8 (1): 41-44.

Mondal AK, Monda A (2011) Studies on antimicrobial activities of some selected ferns and lycophytes in Eastern India with special emphasis on ethno-medicinal uses. Afr *J Pl Sci* 5 (7) 412-420.

Nayar BK (1959) Medicinal ferns of India National Botinacal garden. Lucknow. Ind Bull Number 29 :1-29.

Nayak N, Rath S, Monah PM, Goutam G, Rabindra N (2013) Antibacterial activity of the terrestrial fern *Lygodium flexuosum* (L.) Sw. against multidrug resistant enteric and uropathogenic bacteria. *J Acute Dis* 2(3): 270-276.

Negi S, Tewari M, Pangtey YPS, Kumar S, Martolia A, Upreti K (2009) Taxonomic studies on the family polypodiaceae (Pteridophyta) of Nainital Uttarakhand. *New York Sci J* 2 (5) : 47-83.

Nithin MK, Veeramani G, Sivakrishnan S (2020) Phytochemical screening and GC-MS analysis of rhizome of *Drynaria quercifolia*. *Res J Pharm Tech*. 13(5) : 2266-2268.

Padhy R, Dash SK (2015) Medico-folklore study on some pteridophytes from Kerandimal Hills of South Odisha with emphasis on *Drynaria quercifolia* (Linn.) J Smith *Res J* Pharmaceut *Biolo Chem Sc*i 6 (4) : 2029-2035.

Pargavi B, Sivakumar T (2017) Review on Antimicrobial, Antiox idant, Cytotoxic activity and Phytochemical analysis of *Drynaria quercifolia* and *Decalepsis hamiltonii, Int J Curr Res Chem Pharm Sci* 4(3): 39-45.

Parihar P, Bohra A (2003) Effect of some Pteridophytic plant extracts on human pathogenic bacteria *Salmonella typhi, Ind Fern J* 20 (1,2): 39-41.

Parihar P, Bohra A (2002a) Effect of some Pteridophytic plant part extracts on human pathogenic bacteria *Salmonella typhi* Ad *Pl Sci* 15: 365-367.

Parihar P, Bohra A (2002 b) Antifungal efficacy of various Pteri dophytic plant parts: A study *in vitro Ad. Pl Sci* 15:35-38.

Parihar P, Leena P, Bohra A (2010) In vitro antibacterial activity of fronds (leaves) of some important pteridophytes. J *Microbiol Antimicrobials* 2:19-22.

Pawar V, Chandrashekar KT, Mishra R, Tripathi V, Tripathi K (2017) *Drynaria quercifolia* plant etract as a bone regenerative material in the treatment of periodontal intrabo ny defects:clinical and radiographic assessment, IOSR. *J Dental Med Sci* (IOSR-JDMS), 16(3):93-99.

Paz EA, Lacy RN, Bakhtiar M (1995) The betalactum antibiotics penicillin and Cephalosporin in Prespective Hodder Stong ton, London, pp 227.

Prakash G, Korwar, Beknal AK, Basawaraj S, Patil MA, Halkai Kulkarni, Hariprasanna RC, Soodam RS (2010) A study on phytochemical investigation of *Drynaria quercifolia* linn rhizome, *Int J Pharm Sci Res* 1(12): 148-158.

Prasanna G, Chitra M (2015) Phytochemical screening and GC-MS analysis of *Drynaria quercifolia* rhizome. Am *J Adv Drug Delivery* 3(1): 072-078.

Prasanna G, Anuradha R (2016) A comprehensive review on phytopharmacological activities of *Drynaria quercifolia Int J Pharmacog Phytochem Res* 8 (8) : 1304-1313.

Samydurai P, Thangapandian V, Aravinthan V (2012) Wild hab itats of Kolli Hills being stale food of inhabitant tribes of eastern ghats,Tamil Nadu, India. *Ind J Natural Product* Resour 3 : 432-437.

Sen A, Ghosh PD (2011) A note on the ethnobotanical studies of some pteridophytes in Assam. *Ind J Trad Knowl* 10 : 292–295.

Selvi P, Prasanna G, Anuradha R (2016) Physicochemical and phytochemical analysis of the rhizome of *Drynaria querci folia* L. *Int J Phytopharm Res* 7 (1): 18-22.

Singh R, Gupta AK (2008) Antimicrobial and antitumor activity of the fractionated extracts of Kulimusli (*Curculgo orchioi des*). *Int J Green Pharm* 2(1): 34-36.

Sofowora A (1999) Introduction to medical plants and traditional medicine. *Spectrum books Limited* 2: 8-76.

Sydney S, Lacy RW, Bakhtiar M (1980) The Blactum Antibiotics Penicillin and Cephalosporin in Perspective. Hodder and Stongton, London, pp 224.

Thomas T (2012) In vitro evaluation of antibacterial activity of *Acrostichum aureum* Linn. *Ind J Natural Products Resour* 3 (1): 135-138.

Tomin E, Tomasz A (1986) Betalactam specific resistant mutants of Staphylococcus aureus. *Antimicrobiol. Agents Chemother* 30: 377-383.

Tortora GJ, Funke BR, Case CL (2001) Microbiology: An Introduction. Benjamin Cummings, San Francisco pp 88.

Vilegs JH, DeMarchi E, Lancas FM (1997) Extraction of low polarity compounds from Milania glomerata leaves. *J Phytochem Anal.* 8:266-270.

Viswanathan RN, Saraswathy MB, Balakrishna A, Brindha K, Lakshmanaperumalsamy P (200) Phytochemical and antimicrobial studies on *Drynaria quercifolia. Fitoterapia* 72(8) 934-936.

Yatskieych G (2002) Pteridophytes (ferns) In: Encyclopedia of life Sciences, John Wiley and Sons, Ltd.